AMERICAN MUSEUM NOVITATES

Number 796 — Published by The American Museum of Natural History New York City — May 8, 1935

56.9 (54)

DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. I

AMERICAN MUSEUM COLLECTING LOCALITIES IN NORTHERN INDIA

By Edwin H. Colbert

INTRODUCTION

This is one of a series of papers by the present author setting forth the results of a prolonged study of the collection of Siwalik mammals in The American Museum of Natural History. Eight papers by the writer, descriptive of new or little-known Siwalik mammals in the American Museum collection, have preceded the present contribution, and in addition to these eight papers there have been several papers by other authors dealing with Siwalik fossils in the American Museum. All of these foregoing papers necessarily serve as a partial basis for the study now being offered, and also for an extended monograph, to appear in the near future, which will be concerned with a detailed presentation of researches on the American Museum Siwalik collection.

This and several succeeding papers will epitomize certain aspects of the results obtained from the study of the Siwalik mammals in the American Museum. It has been thought advisable to bring out these contributions antecedent to the large volume, in order that some of the results of particular interest, arising from the Siwalik study, might be made generally available.

I wish to express my appreciation to the Geological Survey of India for permission to reproduce portions of certain geologic maps furnished by them. The maps appearing in this paper were traced from the Indian Survey maps by D. F. Levett Bradley. The charts and diagrams in the following papers were prepared by Margaret Matthew Colbert and D. F. Levett Bradley.

The collection of Siwalik fossils in the American Museum was made by Dr. Barnum Brown, who worked in the Punjab from the latter part of 1921 until the beginning of 1923. During this time a large series of remains of fossil vertebrates was obtained from the Siwalik Series of Upper Tertiary and Lower Pleistocene age. These fossils were found in two general areas, one in the Salt Range between the Jhelum and the

Indus rivers and the other in the Siwalik Hills, between the Sutlej and the Jumna rivers.

The specimens making up the American Museum Siwalik collection were obtained at various levels in the Siwalik Series, and they are representative of the three great Siwalik faunas, namely that of the Lower Siwaliks, that of the Middle Siwaliks, and that of the Upper Siwaliks. The specimens obtained from the first of the two general areas mentioned above are mostly of Lower and Middle Siwalik age, while the specimens collected in the Siwalik Hills are of Upper Siwalik age. By far the greatest number of these specimens are representative of the Mammalia, and these have been the concern of the study now being set forth in this series of papers.

The Importance of Exact Records for Fossils

The collection of Siwalik mammals in the American Museum is especially valuable in that it was made with special regard for exact records of localities and geologic levels. During the course of his field work in the Punjab, Dr. Brown carried a set of topographic sheets, and on these he located as accurately as possible the localities at which fossils were discovered. In his field notes he made records of the stratigraphic occurrences of these fossils. Naturally these careful field records have aided greatly in a proper interpretation of the relations of the several Siwalik faunas, each to the other.

There has been an ever increasing realization of the importance of careful and exact field records for collections of fossils, and as a result palaeontologists and stratigraphers have been devoting an increasing amount of time and care to the compilation of complete records as to localities and stratigraphic levels as an adjunct to collecting expeditions. Geographic and stratigraphic notes of the greatest detail are especially desirable for fossil mammals discovered in continental Tertiary and Quaternary beds, where sedimentary variations are numerous and evolution is rapid.

With these considerations in mind, Dr. Brown kept careful and accurate field records of his collecting localities, as pointed out above, and from his records the maps accompanying this report have been prepared. These maps are published in order that students using the American Museum collection, or the publications dealing with this collection, may locate the positions of the specimens comprising the collection, not only with regard to their geographic occurrences, but also with reference to their stratigraphic positions.

Explanation of Maps

The maps figured on the accompanying pages were drawn up from Indian Geological Survey topographic sheets, on which the geologic formations had been drawn in and colored by members of the Indian Survey. Credit for the geographic and geologic data appearing on these maps should go to the Geological Survey of India.

The first map (Fig. 1) is a general outline map of India, on which is shown the two areas, marked A and B respectively, in which Dr. Brown made the collections of Siwalik mammals for the American Museum.

The two succeeding maps (Figs. 2 and 3) are enlargements of the areas A and B of Fig. 1. On these two maps are marked the numbers and the locations of certain Indian Survey topographic sheets from which the succeeding maps were made. Furthermore, on the two maps under discussion, there are certain areas marked by a stippled design, and these represent the exact locations of the nine detailed maps which follow.

The nine detailed maps (Figs. 4 to 12 inclusive) have been prepared to include most of the localities at which mammalian fossils were discovered by Dr. Brown. An *Hipparion* was found at Hari Talyangar, and a few specimens were discovered at Ramnagar in Kashmir, but it was not thought advisable to prepare separate sheets for these isolated occurrences.

These maps are on a scale of one inch to two miles. The boundaries of the geologic formations are marked by heavy lines, and the several stratigraphic units enclosed within these lines are indicated by certain letters, in the following manner.

Ral	Recent	—Alluvium
Qus	Quaternary	—Upper Siwaliks
Tms	Tertiary	—Middle Siwaliks
Tch	Tertiary	—Lower Siwaliks, Chinji zone
Tka	Tertiary	—Lower Siwaliks, Kamlial zone

The stratigraphic classification used on these maps is that followed by the Indian Geological Survey, according to the official usage of that organization.

The localities at which Dr. Brown obtained the fossils in the American Museum Siwalik collection are indicated by numbers accompanying circles. These are the field numbers used by Dr. Brown in his field notebook. Numbers 1 to 102 inclusive were located by Dr. Brown on topographic sheets when he was in the field, and they represent exact localities at which fossils were found. Numbers 103 to 164 inclusive represent localities that were noted by Dr. Brown in his field records,

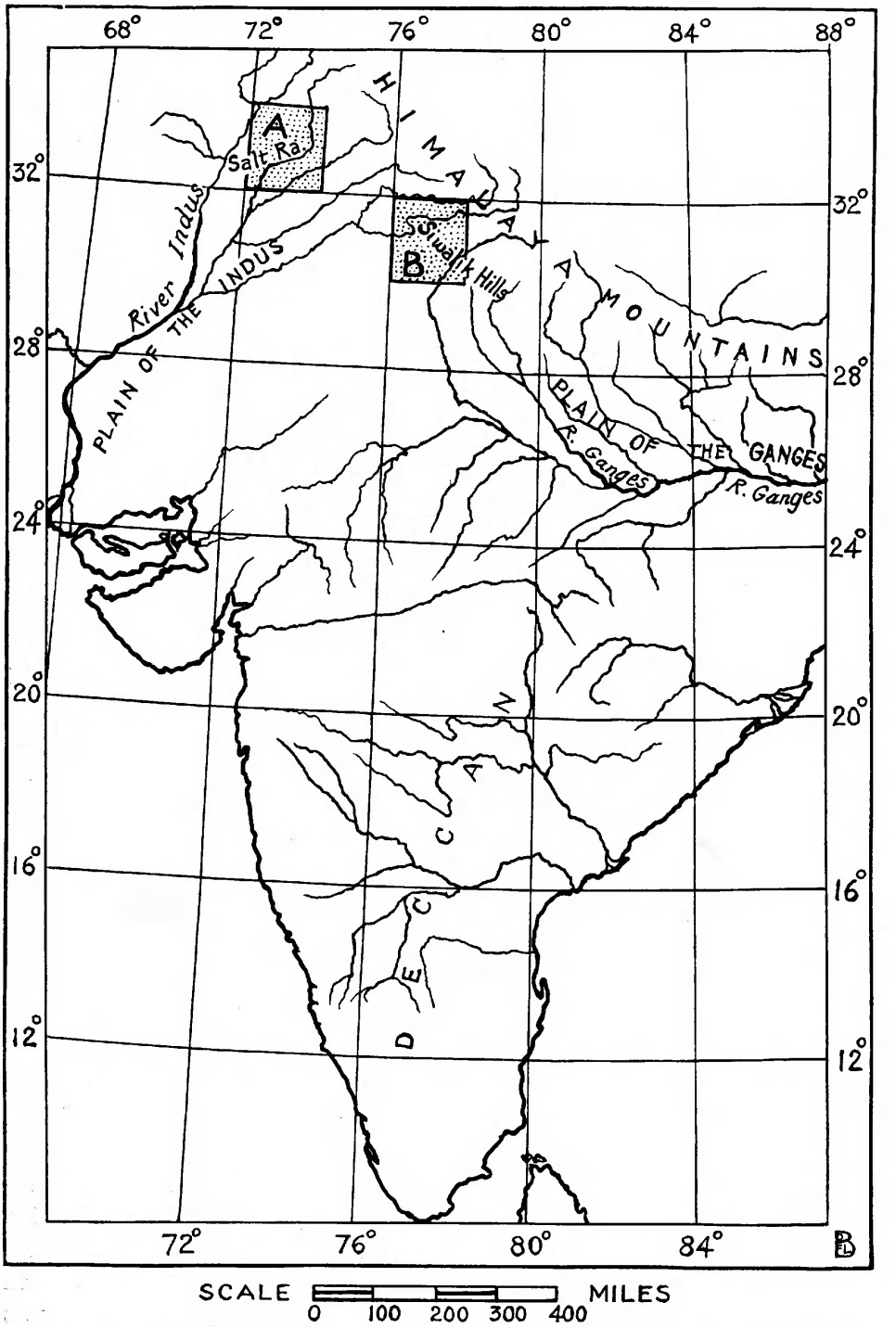

Fig. 1. Map of India, showing location of two key maps, A and B, which include the localities from whence the American Museum Siwalik collection was obtained.

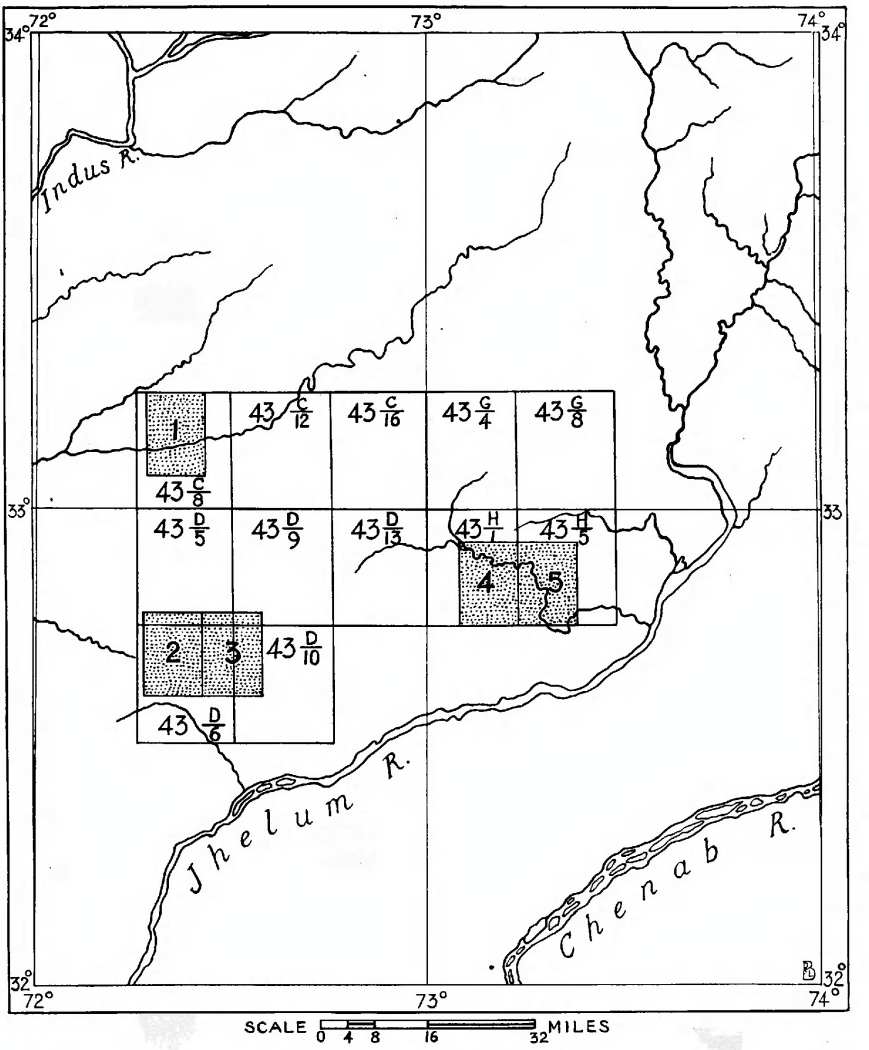

Fig. 2. Key map A (see Fig. 1). This is in the Salt Range area, near the headwaters of the Indus, the Jhelum, and the Chenab rivers. On this map certain Indian Geological Survey sheets are indicated by rectangles and by numbers (43 C/8, 43 C/12, etc.). The stippled rectangles, numbered 1 to 5 inclusive, are the specific areas from which fossils in the American Museum Siwalik collection were obtained. These rectangles (1 to 5) are reproduced in detail in Figs. 4 to 8 inclusive. Scale, 1 inch equals thirty-two miles.

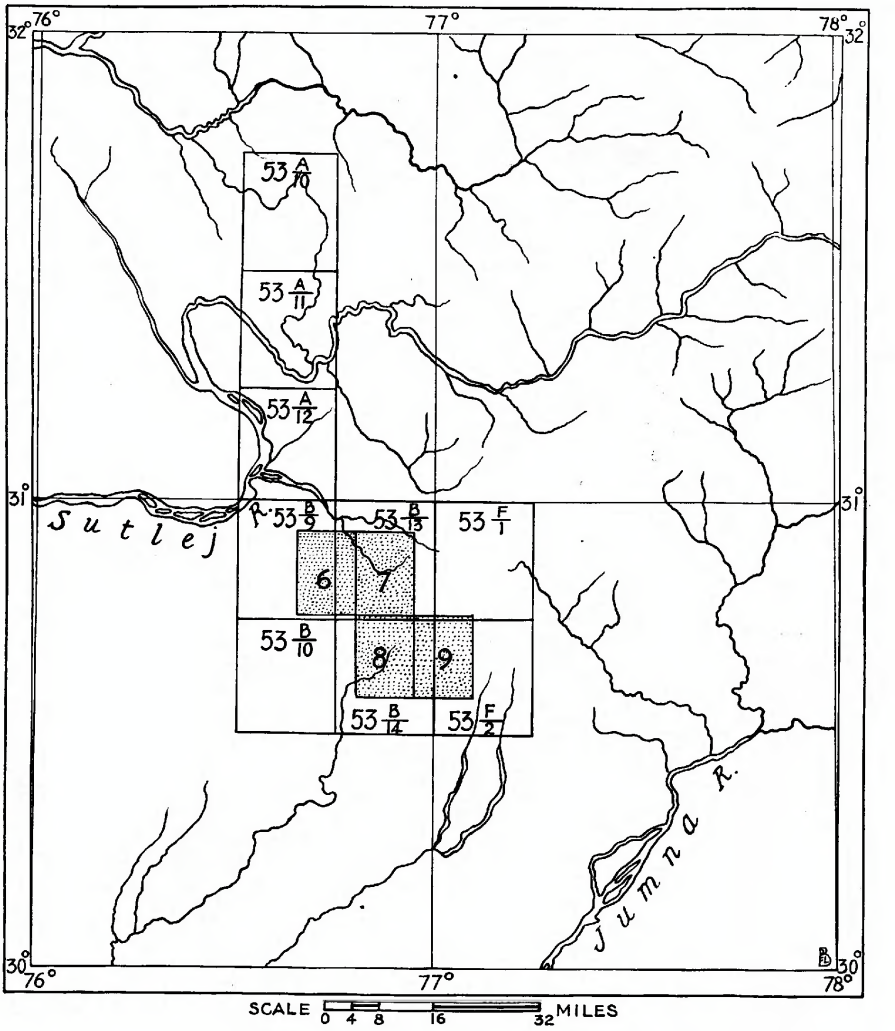

Fig. 3. Key map B (see Fig. 1). This is in the Siwalik Hills region, in the upper reaches of the Sutlej and the Jumna rivers. Indian Geological Survey sheets and stippled rectangles are indicated as in key map A. The stippled rectangles (6 to 9, inclusive) are reproduced in detail in Figs. 9 to 12 inclusive. Scale, 1 inch equals thirty-two miles.

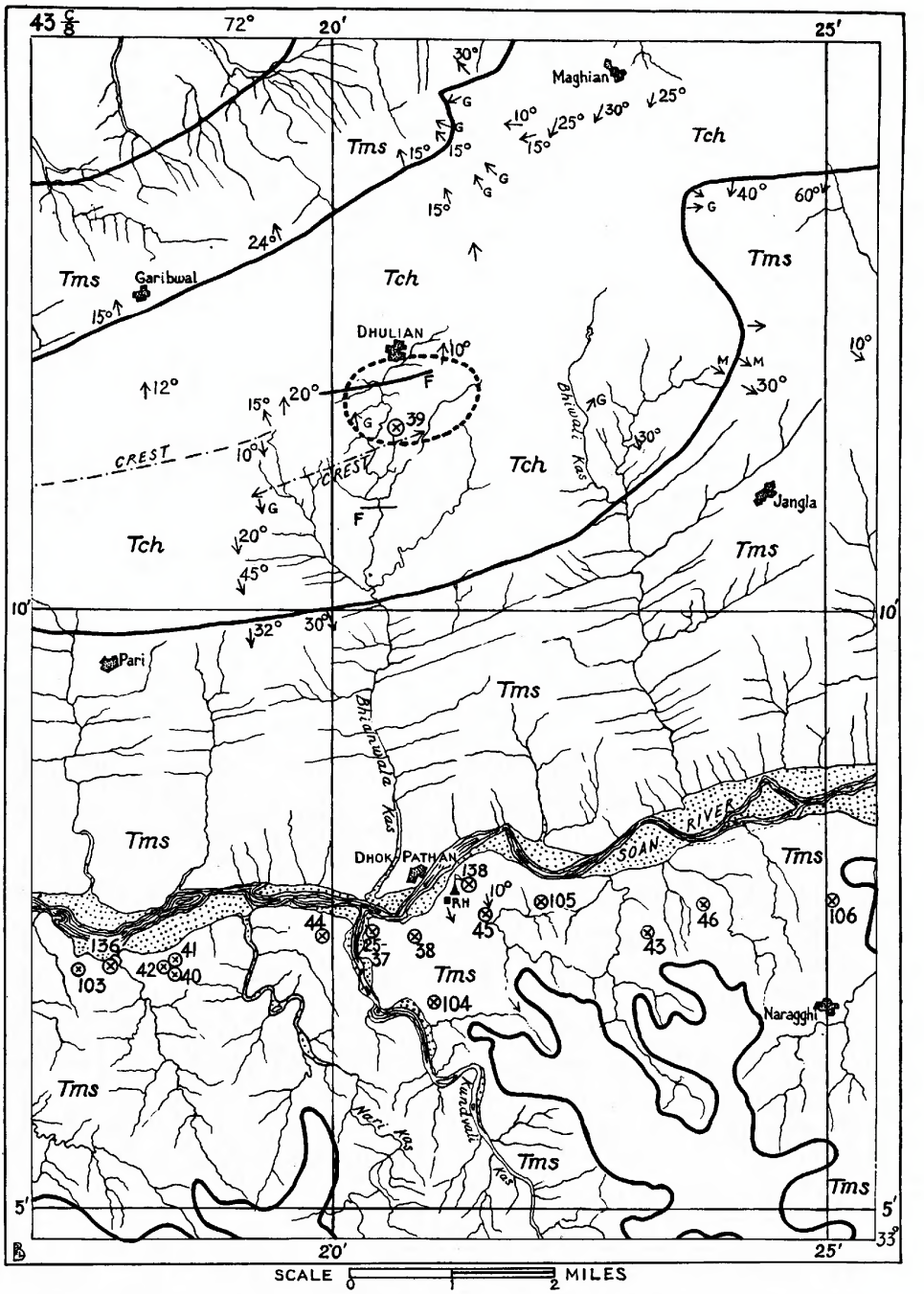

Fig. 4. Rectangle No. 1 of key map A. The region around Dhok Pathan and Dhulian. American Museum fossil localities shown by x, enclosed in circles, with accompanying numbers. Scale, one inch equals two miles.

Tms = Tertiary, Middle Siwaliks; *Tch* = Tertiary, Chinji (Lower Siwaliks).

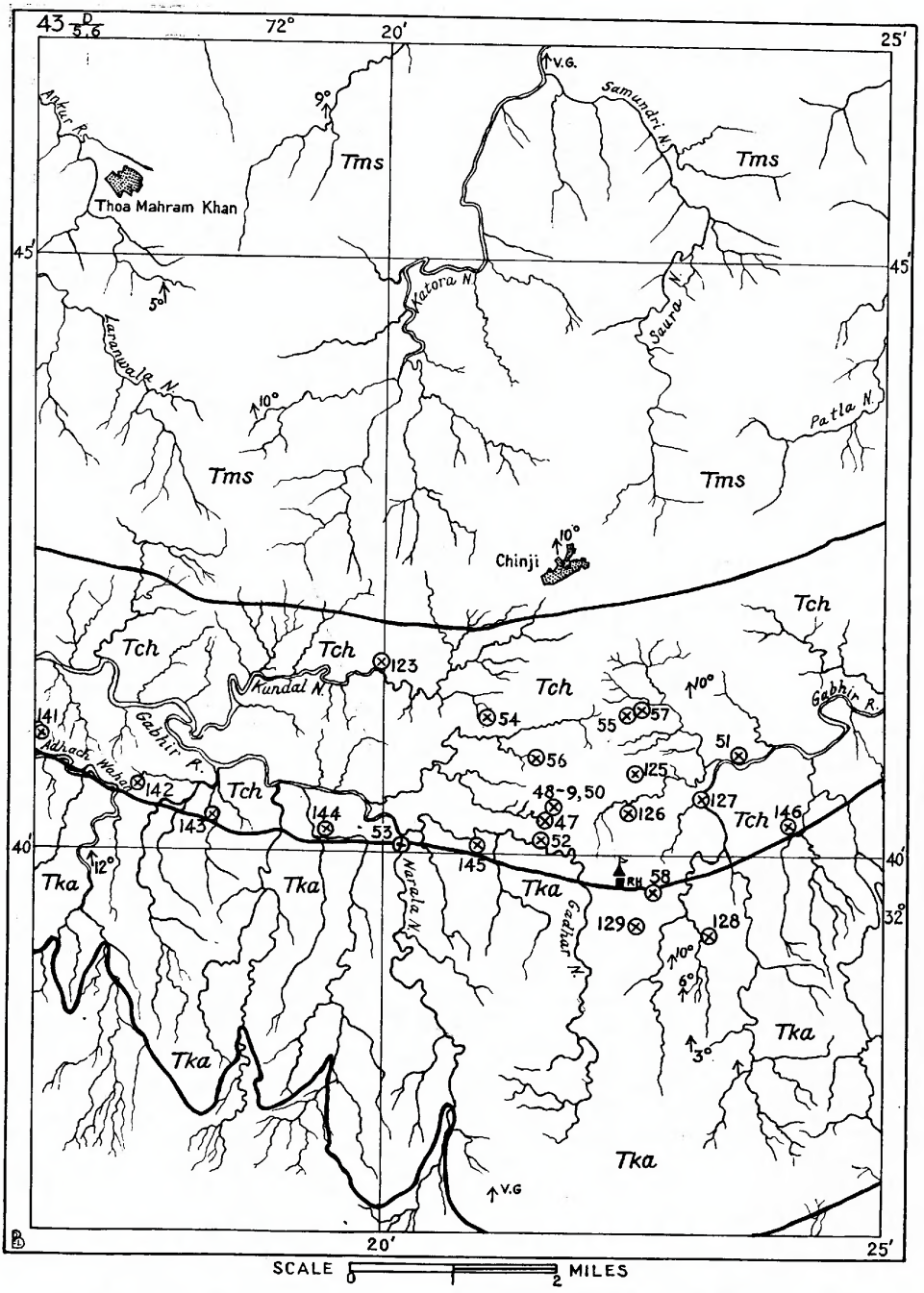

Fig. 5. Rectangle No. 2 of key map A. The region south of Chinji. Scale, one inch equals two miles.

Tms = Tertiary, Middle Siwaliks; *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamlial (Lower Siwaliks).

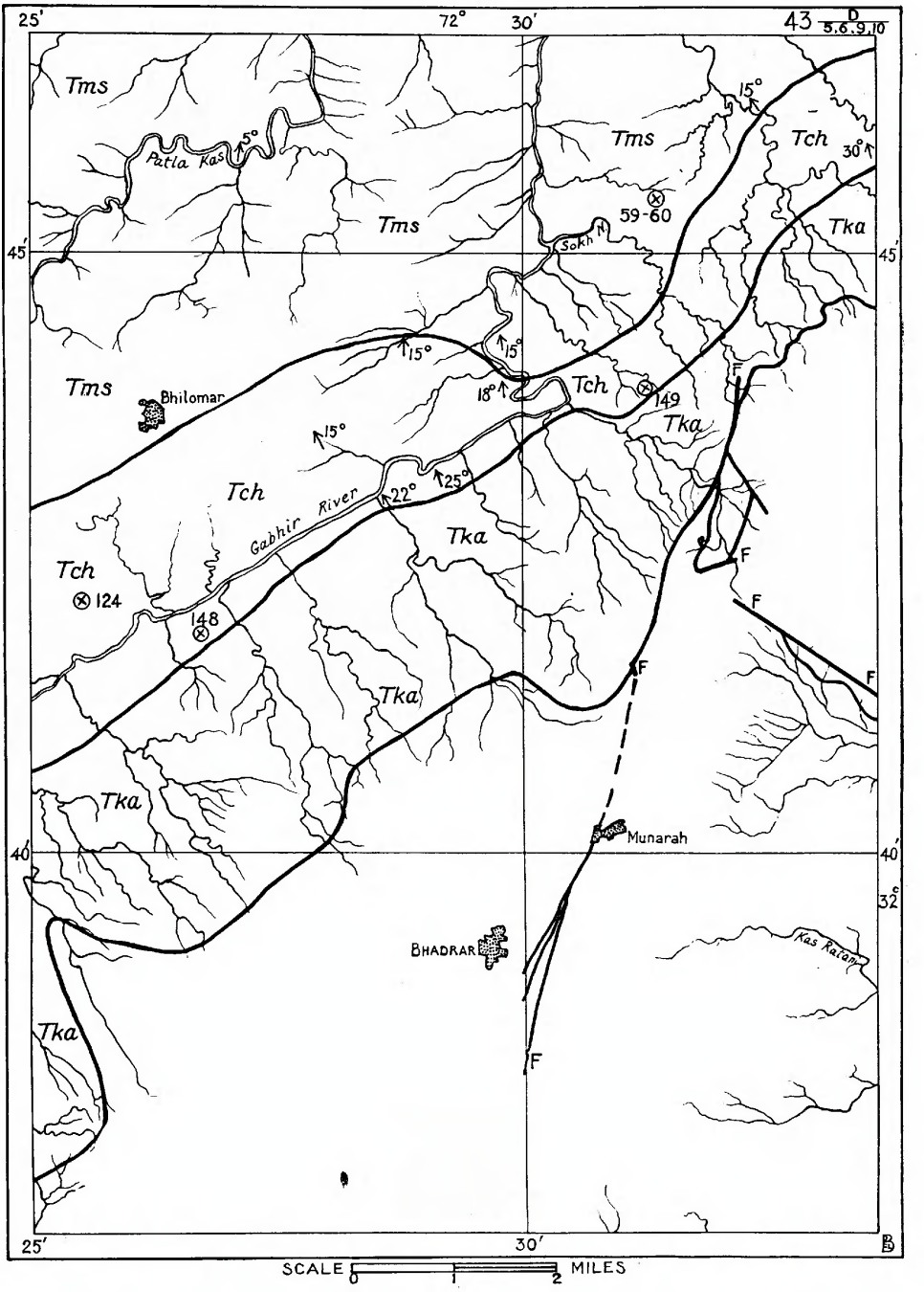

Fig. 6. Rectangle No. 3 of key map A. The region east of Chinji. Scale, one inch equals two miles.

Tms = Tertiary, Middle Siwaliks; *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamlial (Lower Siwaliks).

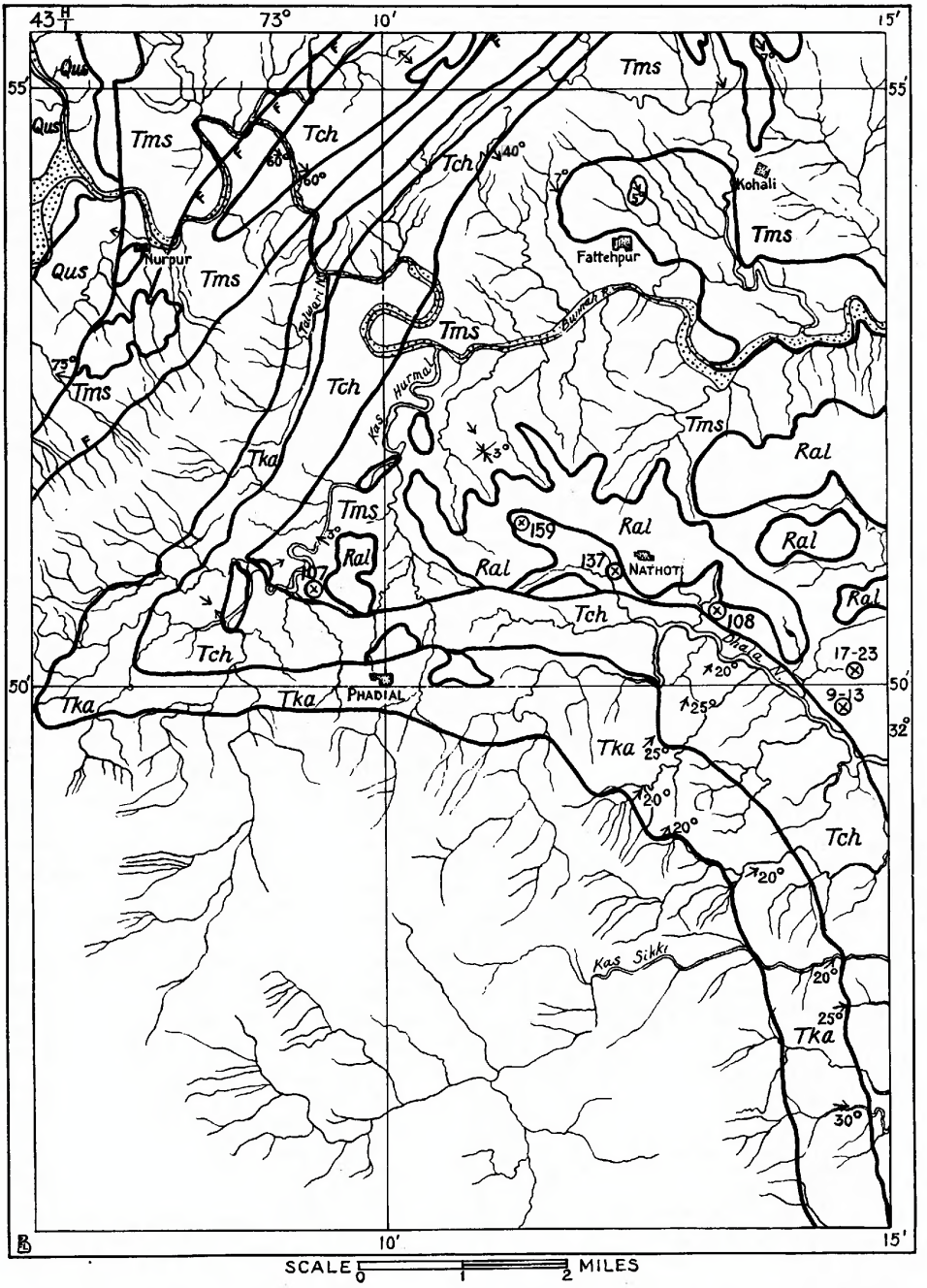

Fig. 7. Rectangle No. 4 of key map A. The region around Nathot. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks; *Tms* = Tertiary, Middle Siwaliks; *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamlial (Lower Siwaliks).

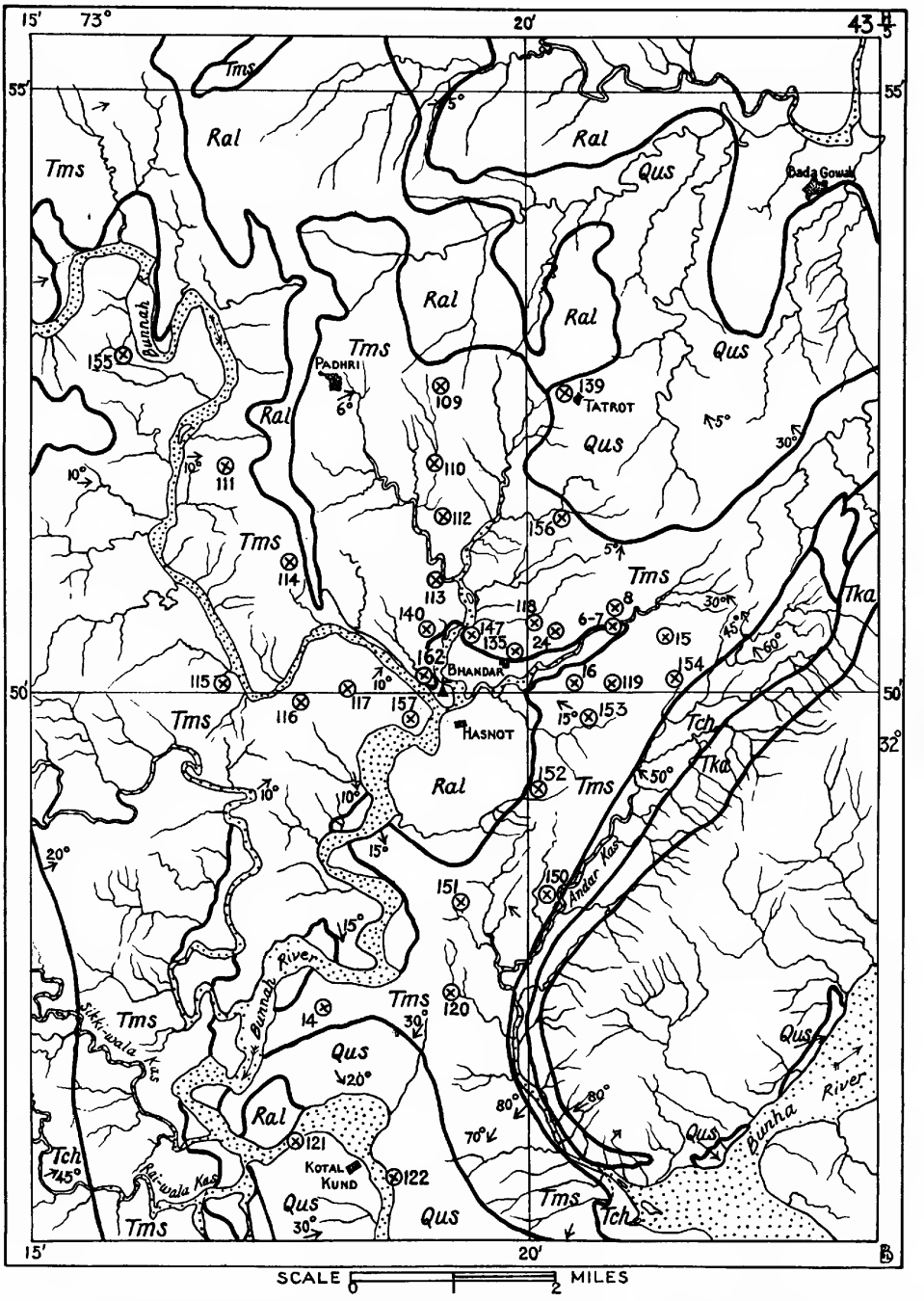

Fig. 8. Rectangle No. 5 of key map A. The region around Hasnot. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks; *Tms* = Tertiary, Middle Siwaliks, *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamlial, (Lower Siwaliks).

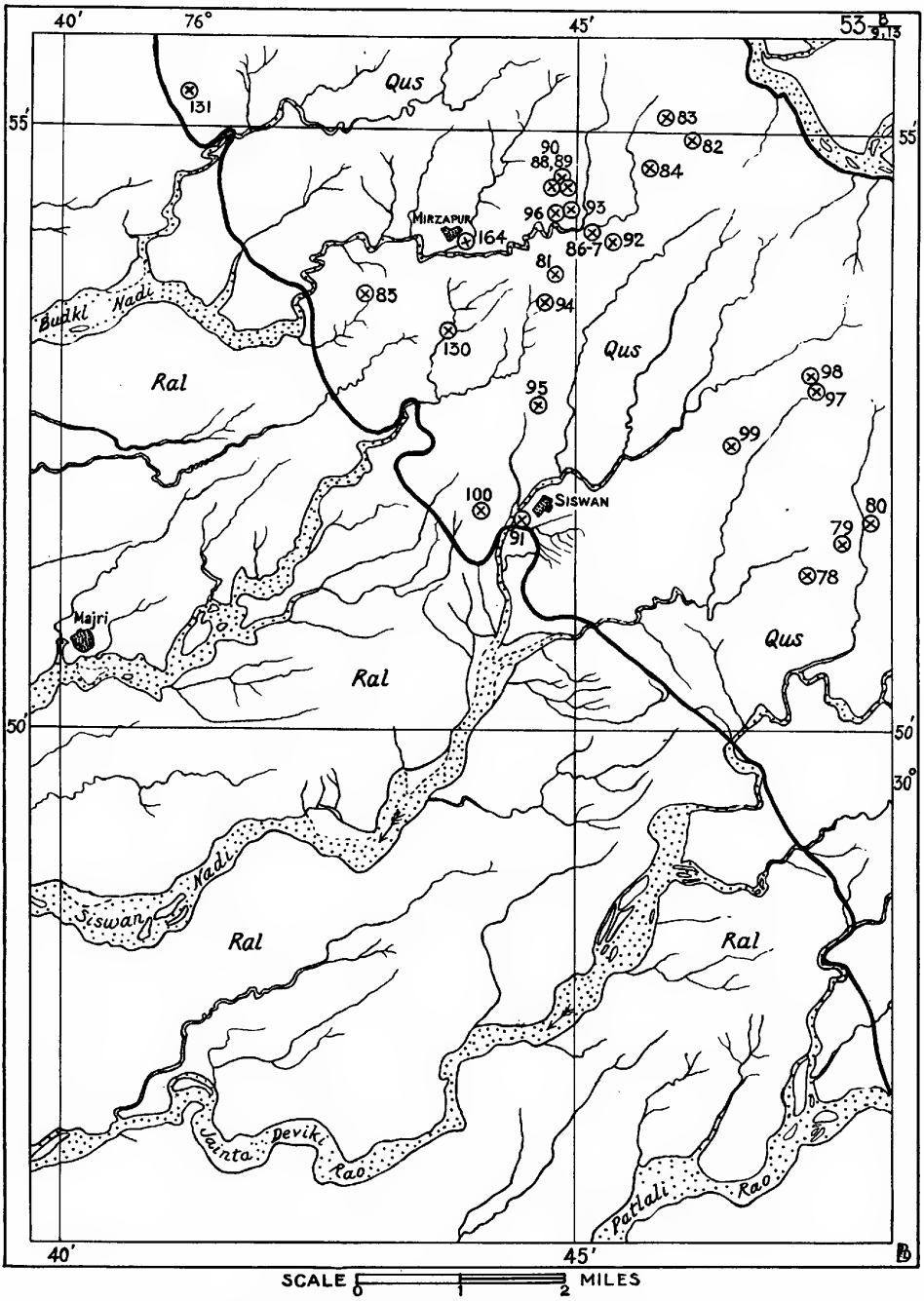

Fig. 9. Rectangle No. 6 of key map B. The region around Siswan. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

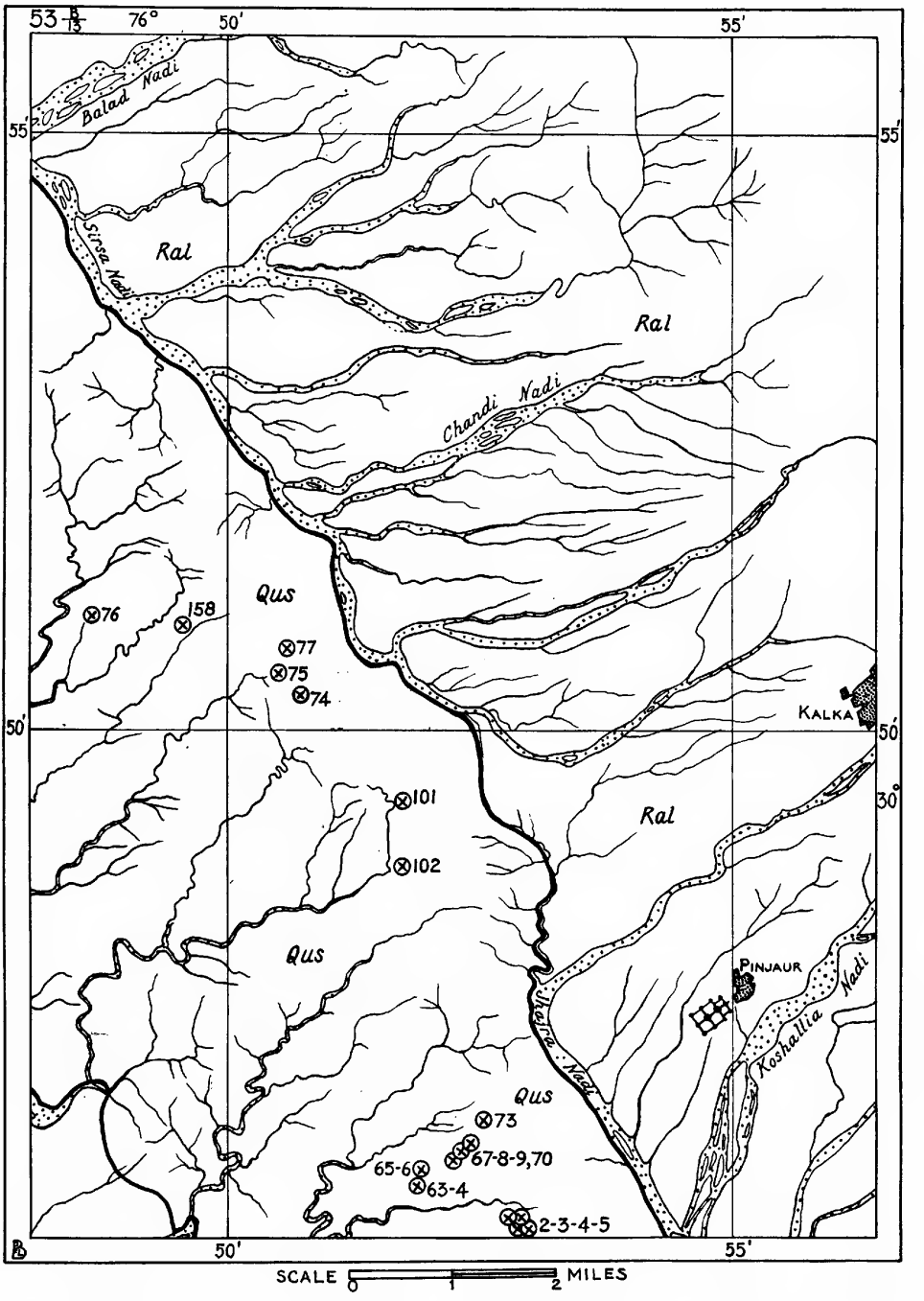

Fig. 10. Rectangle No. 7 of key map B. The region around Pinjaur. Scale, one inch equals two miles.

Ral =Recent, alluvium; *Qus* =Quaternary, Upper Siwaliks.

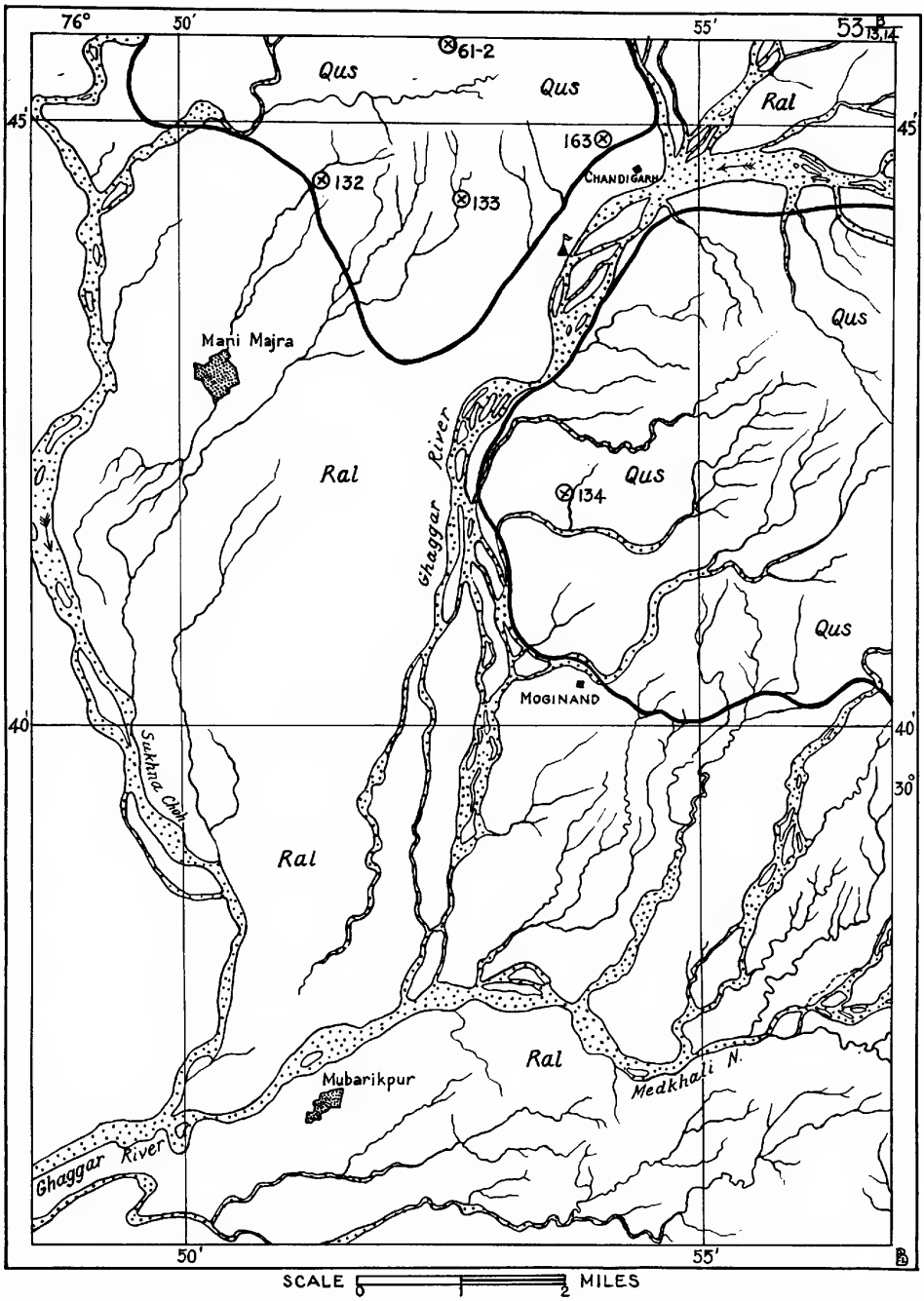

Fig. 11. Rectangle No. 8 of key map B. The region around Chandigarh. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

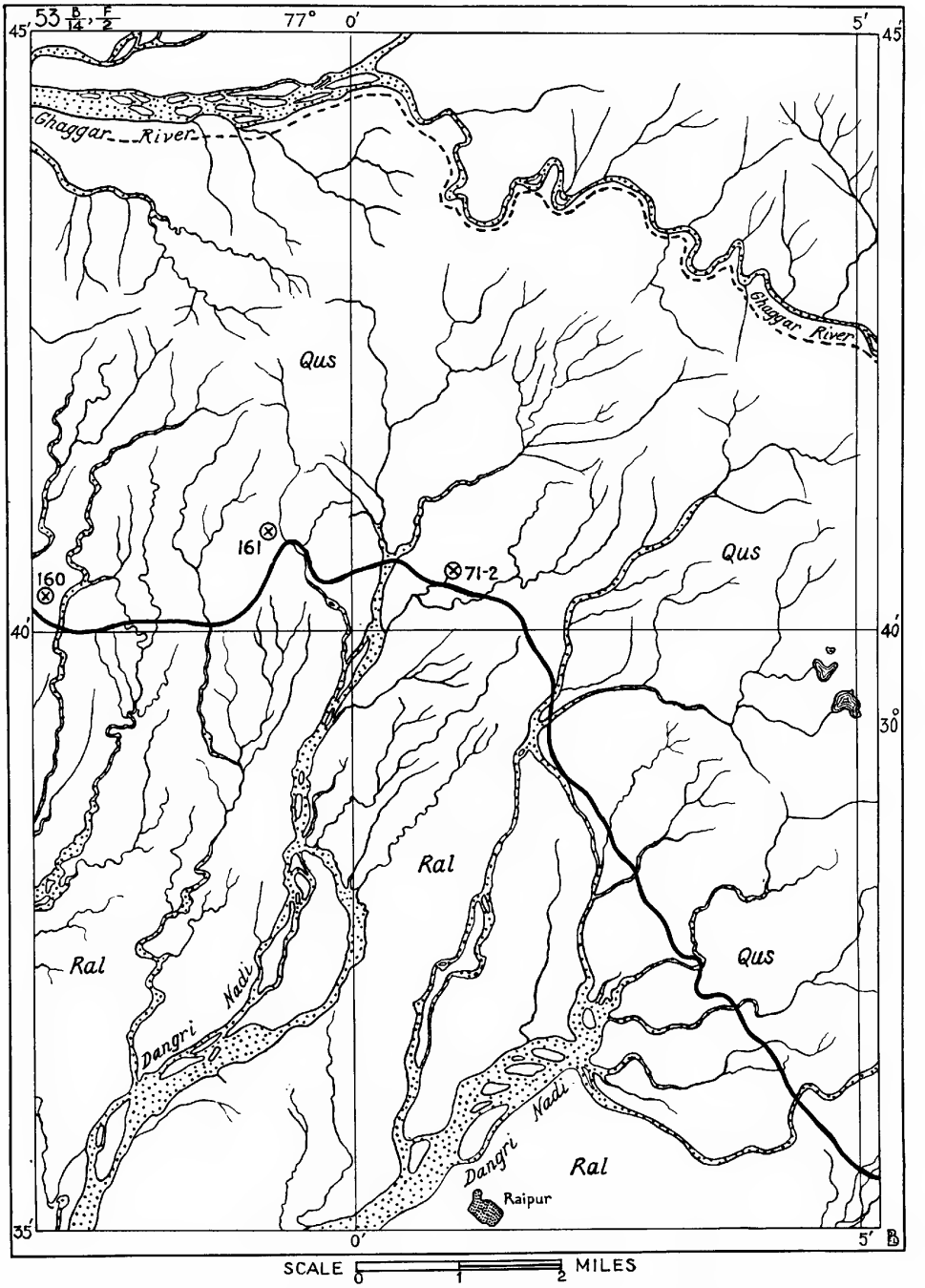

Fig. 12. Rectangle No. 9 of key map B. The region east of Chandigarh. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

but which were not placed on the maps at the time he was in the field. They have been subsequently located, according to the data contained in the field notebook, and naturally their positions are not as exactly determined as are those of the first group of numbers.

With these detailed maps, showing the locations of the boundaries of the several Siwalik divisions, and placing the positions where fossils were discovered, it is possible to fix all of the specimens in the American Museum collection, not only as regards their geographic positions but also as regards the approximate stratigraphic level of each.

Explanation of Locality List

The following list gives the locations and the stratigraphic positions of the one hundred and sixty-four fossil localities which appear on the nine detailed maps (Figs. 4 to 12 inclusive). The localities and their stratigraphic levels are given as they were set down in Dr. Brown's field notebook. In a few cases there are seeming discrepancies between the locality as it is recorded and as it is actually placed on the map, and likewise between the stratigraphic level as recorded in the notebook and as indicated on the map. These supposed discrepancies are due to the fact that it was necessary for Dr. Brown to estimate distances, and these estimated distances often apply to measurement along a trail rather than in a direct line. The positions of fossil localities as indicated on the maps are to be regarded as accurate. Estimates of levels are based on the careful observations of stratigraphic sequences.

Locality List

Field Number	Level	Location
1	Middle Siwaliks	Near Haritalyangar
2, 3, 4, 5	Upper Siwaliks, top of variegated beds below conglomerate	3 miles north west of Chandigarh
6, 7	Upper portion of Middle Siwaliks	1 1/2 miles north east of Hasnot
8	Middle Siwaliks, 100 feet above Bhandar bone bed	1 1/2 miles northeast of Hasnot
9–13	Middle Siwaliks, 1000 feet below Bhandar bone bed	4 1/2 miles west of Hasnot
14	Upper Siwaliks, lower part	3 1/2 miles northwest of Kotal Kund
15	Middle Siwaliks, upper part	2 miles northeast of Hasnot
16	Middle Siwaliks, upper part	1 mile northeast of Hasnot
17–23	Middle Siwaliks, 1000 feet below Bhandar bone bed	4 1/2 miles west of Hasnot
24	Middle Siwaliks, upper part	1/2 mile northeast of Bhandar

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
25–37	Middle Siwaliks, upper part	1/2 mile southwest of Dhok Pathan
38	Middle Siwaliks, upper part	1 mile south of Dhok Pathan
39	Lower Siwaliks, 3000 feet below Dhok Pathan quarry	Dhulian Dome, 6 miles north of Dhok Pathan
40	Middle Siwaliks, upper part	3 miles west of Dhok Pathan
41, 42	Middle Siwaliks, upper part	3 miles west of Dhok Pathan
43	Middle Siwaliks, upper part	2 miles east of Dhok Pathan
44	Middle Siwaliks, upper part	1 mile west of Dhok Pathan
45	Middle Siwaliks, upper part	1/2 mile east of Dhok Pathan
46	Middle Siwaliks, upper part	3 miles east of Dhok Pathan
47	Lower Siwaliks, 1100 feet above Chinji Rest House	1 mile northwest of Chinji Rest House
48–50	Lower Siwaliks, 1600 feet above Chinji R. H.	1 mile northwest of Chinji R. H.
51	Lower Siwaliks, 400 feet above Chinji R. H.	1 1/2 miles northeast of Chinji R. H.
52	Lower Siwaliks, 400 feet above Chinji R. H.	1 mile west of Chinji R. H.
53, 54	Lower Siwaliks	2 miles west of Chinji R. H.
55	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles north of Chinji R. H.
56	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles northwest of Chinji R. H.
57	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles north of Chinji R. H.
58	Lower Siwaliks, 100 feet below Chinji R. H.	At Chinji R. H.
59, 60	Lower Siwaliks, 1600 feet above Chinji R. H.	12 miles east of Chinji R. H.
61, 62	Upper Siwaliks, below conglomerate	2 miles west of Chandigarh
63–70	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
71, 72	Upper Siwaliks, below conglomerate	15 miles east of Chandigarh
73	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
74, 75	Upper Siwaliks, below conglomerate	6 miles west of Kalka
76	Upper Siwaliks, below conglomerate	8 miles west of Kalka
77	Upper Siwaliks, below conglomerate	6 miles west of Kalka
78–80	Upper Siwaliks, below conglomerate	9 miles west of Kalka
81	Upper Siwaliks, upper clays below conglomerate	1 mile east of Mirzapur
82–84	Upper Siwaliks, upper clays below conglomerate	3 miles northeast of Mirzapur
85	Upper Siwaliks, upper clays below conglomerate	1 mile southwest of Mirzapur
86–87	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
88	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
89	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
90	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
91	Upper Siwaliks, base of conglomerate	Siswan
92	Upper Siwaliks, below conglomerate	3 miles north of Siswan
93	Upper Siwaliks, below conglomerate	3 miles north of Siswan
94	Upper Siwaliks, below conglomerate	2 miles north Siswan
95	Upper Siwaliks, below conglomerate	1 mile north of Siswan
96	Upper Siwaliks, below conglomerate	1 mile east of Mirzapur
97, 98	Upper Siwaliks, below conglomerate	3 miles northeast of Siswan
99	Upper Siwaliks, below conglomerate	2 miles northeast of Siswan
100	Upper Siwaliks, near top of conglomerate	1/2 mile west of Siswan
101	Upper Siwaliks, below conglomerate	2 miles south of Charnian
102	Upper Siwaliks, below conglomerate	2 1/2 miles south of Charnian
103	Middle Siwaliks, upper part	4 miles west of Dhok Pathan
104	Middle Siwaliks, upper part	1 mile south of Dhok Pathan
105	Middle Siwaliks, upper part	1 mile east of Dhok Pathan
106	Middle Siwaliks, upper part	4 miles east of Dhok Pathan
107	Middle Siwaliks, lower part	1/2 mile west of Phadial
108	Middle Siwaliks, 200 feet lower than Nos. 17–23	1 mile south of Nathot
109	Middle Siwaliks, (?) upper part, or Upper Siwaliks (?) lower part	3 miles north of Hasnot
110	Middle Siwaliks, upper part	2 miles north of Hasnot
111	Middle Siwaliks, upper part	3 miles northwest of Hasnot
112	Middle Siwaliks, upper part	1 1/2 miles north of Hasnot
113	Middle Siwaliks, upper part	1 mile north of Hasnot
114	Middle Siwaliks, upper part	2 miles northwest of Hasnot
115	Middle Siwaliks, 500 feet below Bhandar bone bed	2 miles west of Hasnot
116	Middle Siwaliks, 500 feet below Bhandar bone bed	1 1/2 miles west of Hasnot
117	Middle Siwaliks, upper part	1 mile west of Hasnot
118	Middle Siwaliks, upper part	1 mile northeast of Hasnot
119	Middle Siwaliks, upper part	1 1/2 miles east of Hasnot
120	Middle Siwaliks, upper part, or Upper Siwaliks, lower part	3 miles south of Hasnot
121	Upper Siwaliks	1/2 mile northwest of Kotal Kund
122	Upper Siwaliks	1/2 mile east of Kotal Kund
123	Lower Siwaliks, 1600 feet above Chinji R. H.	3 miles northwest of Chinji R. H.

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
124	Lower Siwaliks, level of Chinji R. H.	4 miles northeast of Chinji R. H.
125	Lower Siwaliks, 600 feet above Chinji R. H.	1 mile north of Chinji R. H.
126	Lower Siwaliks, 200 feet above Chinji R. H.	1/2 mile north of Chinji R. H.
127	Lower Siwaliks, 100 feet above Chinji R. H.	1 mile northeast of Chinji R. H.
128	Base of Lower Siwaliks	1 mile southeast of Chinji R. H.
129	Lower Siwaliks, 100 feet below Chinji R. H.	1/2 mile south of Chinji R. H.
130	Upper Siwaliks, middle of conglomerate	1 mile south of Mirzapur
131	Upper Siwaliks, below conglomerate	4 miles west of Mirzapur
132	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
133	Upper Siwaliks, below conglomerate	1 mile west of Chandigarh
134	Upper Siwaliks, below conglomerate	2 1/2 miles south of Chandigarh
135	Middle Siwaliks, 100 feet above bone bed	At Bhandar
136	Middle Siwaliks, same level as No. 40	3 1/2 miles west of Dhok Pathan
137	Middle Siwaliks, near base	Near Nathot
138	Middle Siwaliks, upper part	Near Dhok Pathan
139	Middle Siwaliks, upper part, or Upper Siwaliks, lower part	At Tatrot
140	Middle Siwaliks, upper part	1/2 mile north of Hasnot
141	Lower Siwaliks	6 miles west of Chinji
142	Lower Siwaliks	5 miles west of Chinji
143	Lower Siwaliks, 100 feet above Chinji R. H.	4 miles west of Chinji
144	Lower Siwaliks, 400 feet above Chinji R. H.	3 miles west of Chinji R. H.
145	Lower Siwaliks, 500 feet above Chinji R. H.	1 1/2 miles west of Chinji R. H.
146	Lower Siwaliks	1 1/2 miles east of Chinji R. H.
147	Middle Siwaliks, upper part	1/2 mile northeast of Hasnot
148	Lower Siwaliks	5 miles east of Chinji R. H.
149	Lower Siwaliks	10 miles east of Chinji R. H.
150	Middle Siwaliks, near base	2 miles south of Hasnot
151	Middle Siwaliks, upper part	2 miles south of Hasnot
152	Middle Siwaliks	1/2 mile southeast of Hasnot
153	Middle Siwaliks, 200 feet below Bhandar bone bed	1 mile east of Hasnot
154	Middle Siwaliks, upper part	2 miles east of Hasnot
155	Middle Siwaliks, 100 feet below Bhandar bone bed	4 1/2 miles northwest of Hasnot

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
156	Middle Siwaliks, upper part	2 1/2 miles northeast of Hasnot
157	Middle Siwaliks, upper part	1/2 mile southwest of Hasnot
158	Upper Siwaliks	7 miles west of Kalka
159	Middle Siwaliks, lower part	2 miles northeast of Phadial
160	Upper Siwaliks, below conglomerate	6 miles east of Chandigarh
161	Upper Siwaliks, below conglomerate	12 miles east of Chandigarh
162	Middle Siwaliks, upper part	At Hasnot
163	Upper Siwaliks	At Chandigarh
164	Upper Siwaliks, below conglomerate	At Mirzapur

NOTE.—Numbers 14, 59, and 60 are located on the accompanying maps in the positions recorded for them on the field maps. Evidently they are misplaced. Number 14 should be in the Upper Siwaliks, numbers 59 and 60 in the Lower Siwaliks.

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